SCAFFOLD: Innovative strategies, methods and tools for managing occupational nano-risks in construction

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Nanosafety Cluster Review Meeting, 10&11 December, 2014

SEVENTH FRAMEWORK PROGRAMME
GA: 280535

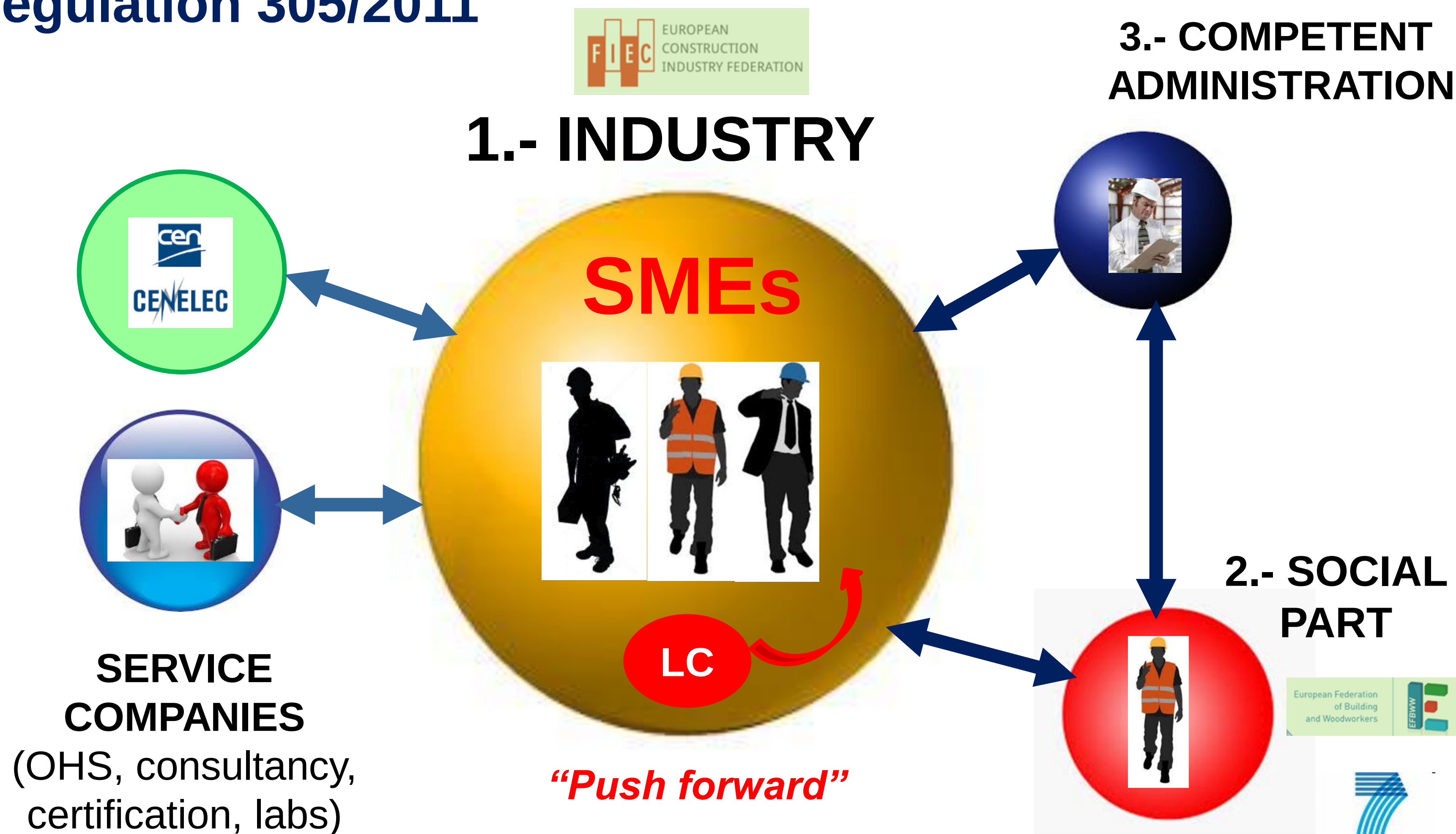
CONTRUCTION (EU28, 2013)

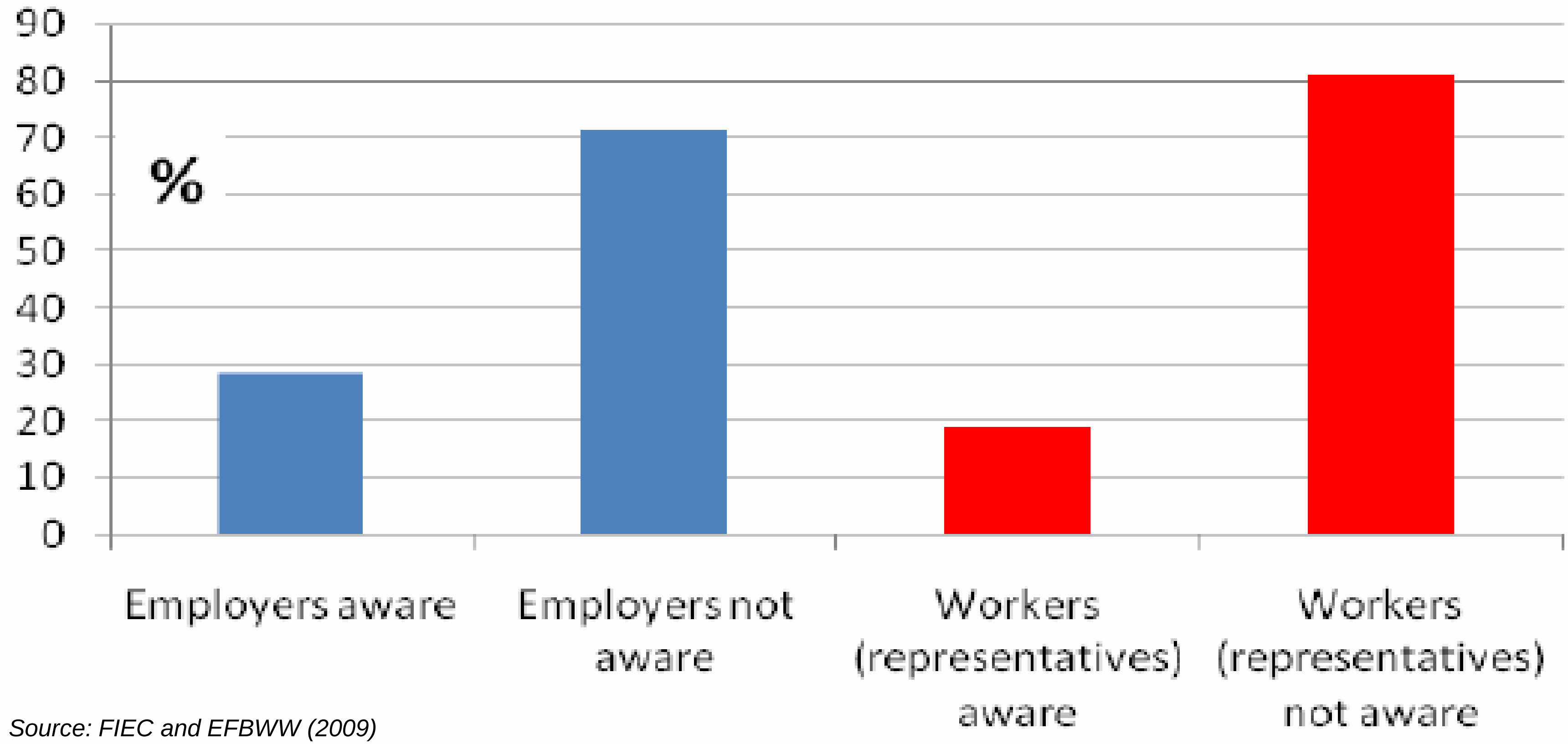
- ***Biggest employer**: 13,9 M jobs (6,4 % total employment and 29 % of industrial employment)*
- ***Industry dominated by SMEs**: 2,9 M of enterprises (99,9 % SMEs, 93 % < 10 workers)*
- ***Economic power:** 8,8 of GDP*
- ***Subcontracting:** (45 %)*
- ***Poor OHS performance**: Close to one in four (23.1 %) fatal accidents at work took place within the construction sector*

GA: 280535

Innovative strategies, methods and tools for occupational risks management of manufactured nanomaterials in the construction industry

- **Directive 89/391/EEC,** 98/24/EC, 2004/37/EC
- **Regulation 305/2011**





Source: FIEC and EFBWW (2009)

- "In the light of current knowledge and opinions of the EU Scientific and Advisory Committees and independent risk assessors, nanomaterials are similar to normal chemicals / substances **in that some may be toxic and some may not**. Possible risks are related to specific nanomaterials and specific uses" *COM(2012) 572 final, Second Regulatory Review on Nanomaterials*

- "The employer shall have a **duty to ensure** the safety and health of workers **in every aspect related to the work**".

- "The employer shall be **alert** to the need to adjust these measures to take account of **changing circumstances** and aim to improve existing situations" (Directive 89/391/EEC).

Industry needs

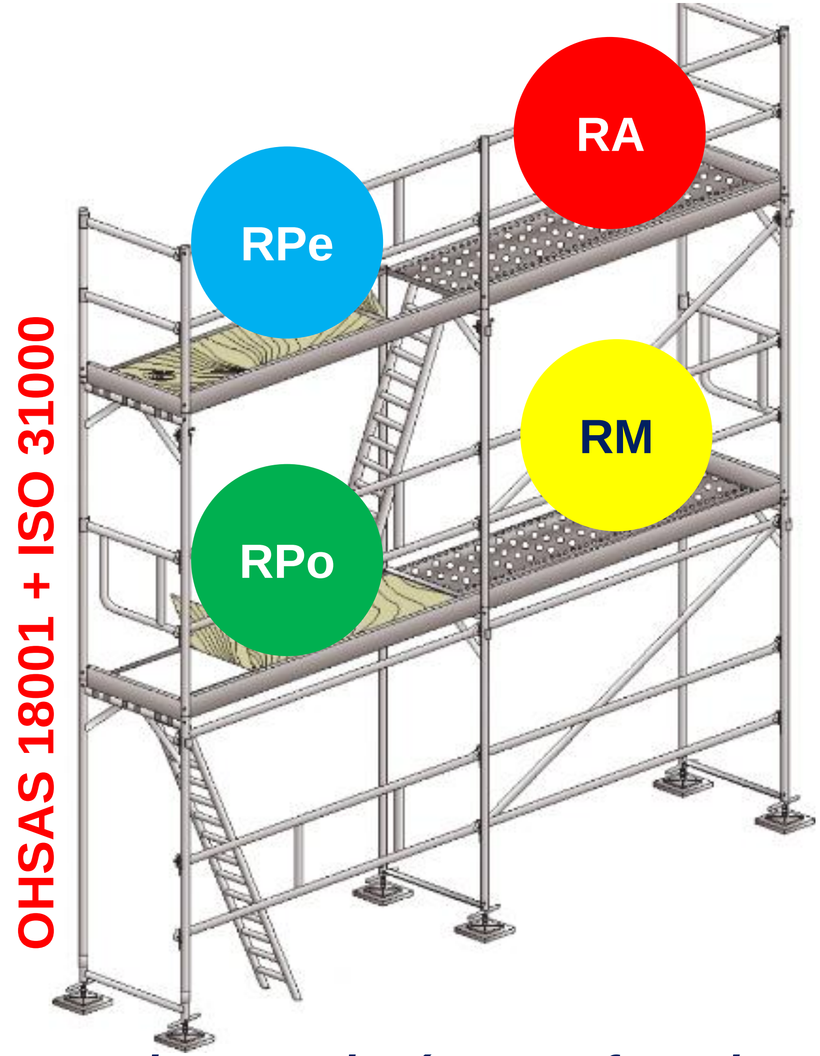
- Companies and workers are using and handling MNMs and nano-products in construction
- Exposures are produced at different stages of the construction industry life cycle
- Legal uncertainty
- Proactive approach (98/24/EC):
  - Prevention of risks
  - Assessment of risks
  - Specific protection and prevention measures
  - Arrangements to deal with accidents, incidents and emergencies
  - Information and training for workers
  - Occupational exposure limit value
  - Consultation and participation of workers
  - Health surveillance

SCAFFOLD is an **industry-oriented** idea specifically focussed on providing **practical, robust, easy-to-use and cost effective solutions** to the **European construction industry**, regarding current **uncertainties** about occupational exposure to MNMs.

Scaffold Objective

Risk management *refers to the architecture that is used to manage risk [Adapted from ISO 31000]* **.**

The aim of the SCAFFOLD project is to **develop, test, validate in real conditions and disseminate** a **new holistic, consistent and cost effective Risk Management Model (RMM) to manage occupational exposure to MNMs in construction.**



- ***Project results (Nanosafety cluster)***
- ***New research (Scaffold)***

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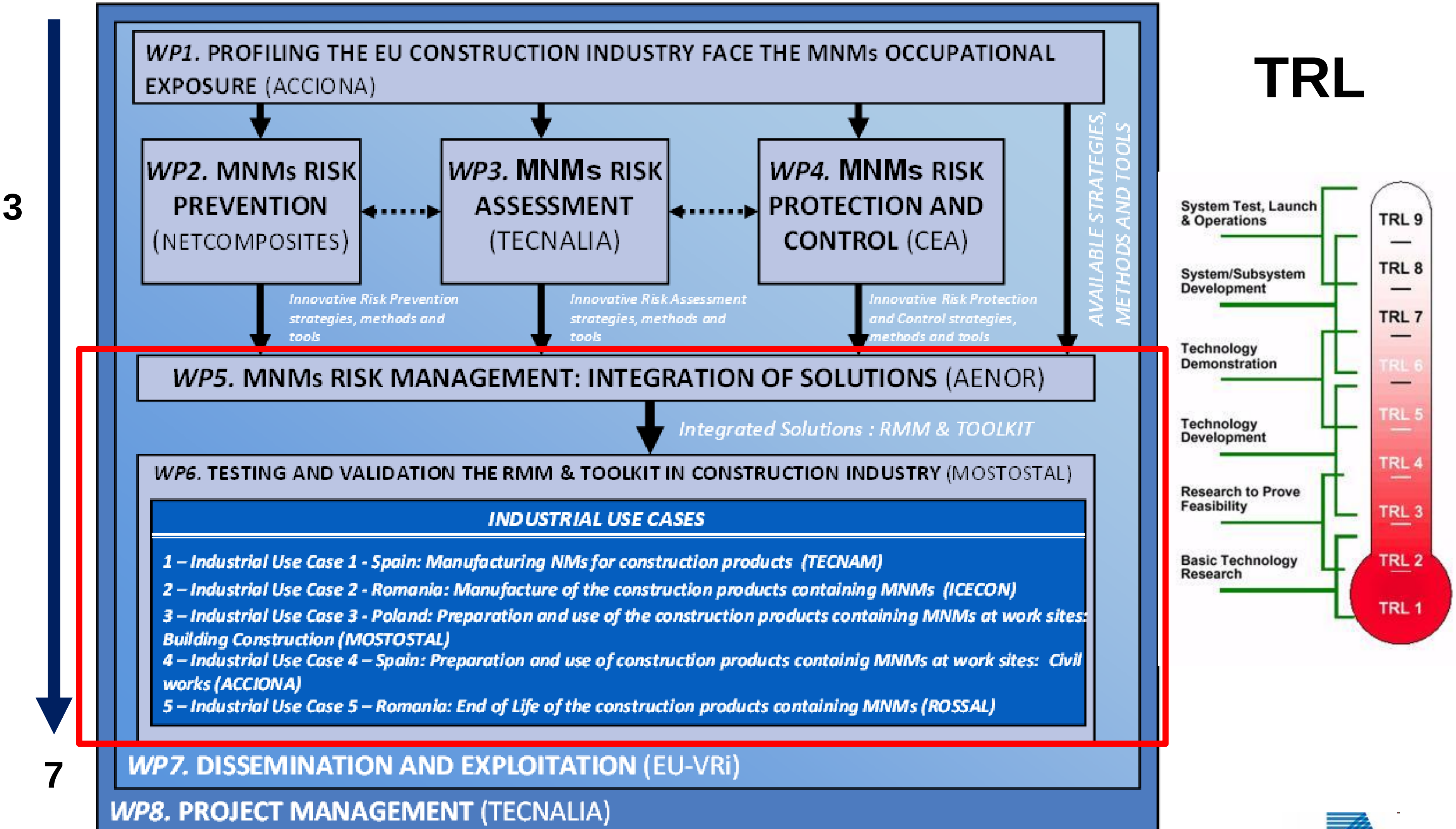
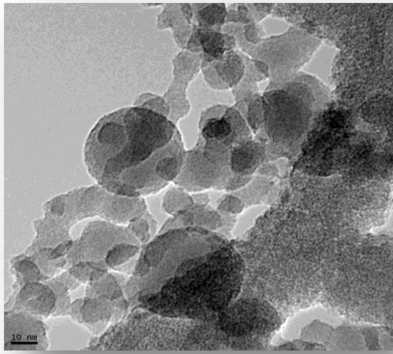


- **Six applications of MNMs in construction**:

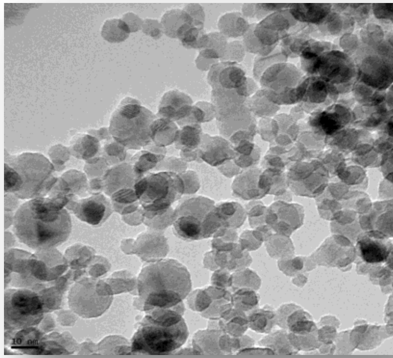
  1. Depollutant mortars
  2. Self-compacting concretes
  3. Stabilised, bituminous road-surface (Coating laminates)
  4. Self-cleaning external coatings
  5. Fire-resistant panels and
  6. Insulations



- **Five MNMs**: TiO_2, SiO_2, Cellulose Nanofibres, Carbon Nanofibres and Nanoclays

- **Six categories of exposure scenarios** (integrating 26 individual exposure scenarios):

  1. Manufacturing NMs
  2. Manufacturing products containing MNMs,
  3. Preparation, mixing, and application on site
  4. Assembly and machining
  5. Demolition and disposal
  6. Accidental fires (Combustion of MNMs)



Category of exposure scenario	MNM and application				
	nano-TiO2 (NPs, depollutant mortar & self-cleaning coatings)	**nano-SiO2** (NPs, self-compacting concrete)	**nano-Clay** (fire retardant panels)	**Carbon nano-fibres** (coating laminates)	**nano-cellulose** (insulation)
1.- MNM manufacturing					
2.- Manufacturing products containing MNMs					
3.- Application / assembling on-site					
4.- Machining					
5.- Demolition					
6.- Accidental fires					

Some Significant results (November 2014)

1. **Safer nano-enabled products for construction**: dispersions, formulations for fire-retardant panels, concretes, bituminous pavements, coatings, insulations.
2. **General quantitative** (CB ISO 12901-2) and **qualitative approaches** for **Risk Assessment**, including specific procedures, strategies and methods for measuring exposures (TiO2, SiO2, CNF, CNF and nanoclays), proposals for OELs, models,,etc (5 IUCs on-going)
3. Assessment of **22 specific exposure scenarios at lab and pilot scales (Database)**, involving on-line equipment (portable + advanced), personal samplers, chemical-SEM-EDX .. analysis of samples, …
4. Evaluation of the **efficiency of collective protections** (LEV, glove-box, ..) and **PPEs** (suits, respirators, gloves)
5. **New device** for trapping nanoparticles


Scaffold Toolkit
File
[M1] Library
[M2] Customization
[M3] Risk management
[M4] Tools
[M5] Help
Window
SCAFFOLD TOOLKIT V0.1
Managing Occupational Nano-risks in Construction
SEVENTH FRAMEWORK PROGRAMME
GA-280535

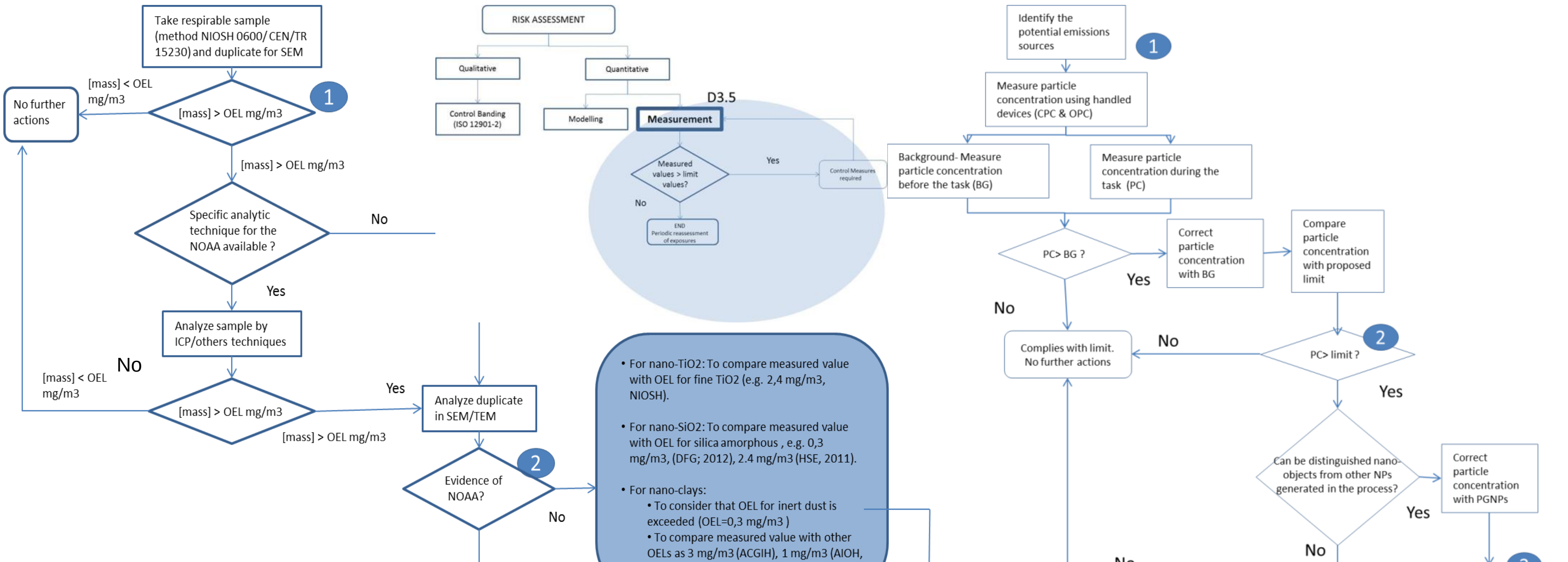


Table 2 — Control band matrix as a result of hazard band and exposure potential band

		Emission potential band			
		EB 1	EB 2	EB 3	EB 4
Hazard band	A	CB 1	CB 1	CB 1	CB 2
	B	CB 1	CB 1	CB 2	CB 3
	C	CB 2	CB 3	CB 3	CB 4
	D	CB 3	CB 4	CB 4	CB 5
	E	CB 4	CB 5	CB 5	CB 5

Table 1. OELs proposed in Scaffold project.

Nano-object	OELs Mass (mg/cm3) / Fibers (fibers/cm3)
nano-TiO2	0.1 (respirable)
nano-SiO2	0.3 (respirable
nano-clays	0.3 (respirable)
"inert dust (granular nanomaterial)"	0.3 (respirable) 4 (inhalable)
CNF	0.01 (a)
nano-cellulose	0.01 (a)

(a) In fibers/cm3

SEVENTH FRAMEWORK PROGRAMME
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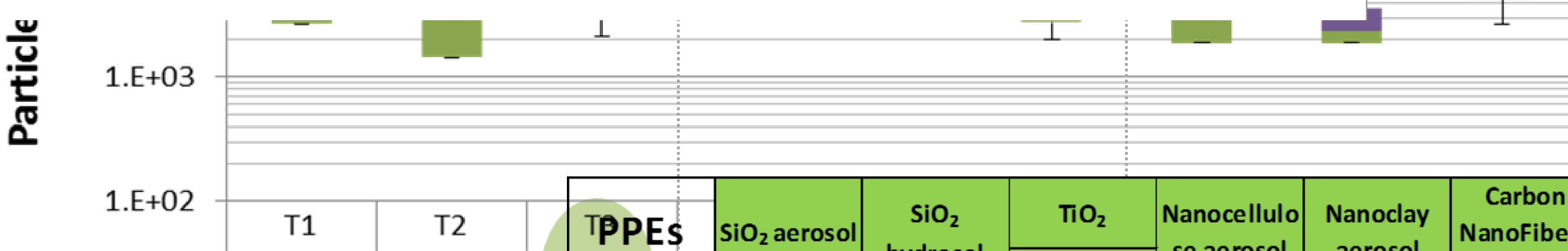
PROCESS								Particles	Partic
PROCESS Operation	Nano-Object	Application	Code	Exposure Scenario	Task Description	Engineering Controls	Measurement procedure	Device	Mean(#/
Building	Nano-clay	FR panels	ES20	On site assembly/Machining- Control	Machining	Out door	1. Release	ELPI (#/cm3)	5,04E-
Building	Nano-clay	FR panels	ES20	On site assembly/Machining- Material B	Machining	Out door	1. Release	ELPI (#/cm3)	5,90E-
Building	Nano-clay	FR panels	ES20	On site assembly/Machining- Material C	Machining	Out door	1. Release	ELPI (#/cm3)	6,28E-
Building	Nano-clay	FR panels	ES20	Background	Background	Out door	1. Release	ELPI (#/cm3)	4,54E-
Building	Nano-clay	FR panels	ES21	Demolition-Composite (PA - 50% FV) (control)	Shredding	Out door	1. Release	ELPI (#/cm3)	1,91E-
Building	Nano-clay	FR panels	ES21	Demolition-Composite (PA - 40 %FV) (Material B 5 %nanoclay))	Shredding	Out door	1. Release	ELPI (#/cm3)	1,90E-
Building	Nano-clay	FR panels	ES21	Demolition-Composite (PA - 30% FV) (Material C 5 %nanoclay))	Shredding	Out door	1. Release	ELPI (#/cm3)	1,55E-
Building	Nano-clay	FR panels	ES21	Background	Background	Out door	1. Release	ELPI (#/cm3)	5,96E-
Building	Nano-clay	FR panels	ES22	Accidental fire: MNMs combustion Material A	Fire				
Building	Nano-clay	FR panels	ES22	Accidental fire: MNMs combustion Material C (1.25 % nano-clay)	Fire				

…ot, background-
…ted average number
…oparticles/cm3 during
…sks (data from
…007).
…TWA calculated
…ing 8 h/day, 40 h per



	T1	T2
	Material A	
8-hr TWA (mg/m3)		0.003
TiO2-Conctr. (mg/m3)		0.003
Sampling Time (min)		41
Mean (particles/cm3)	14098	3725

PPEs	SiO_2 aerosol	SiO_2 hydrosol	TiO_2 aerosol	Nanocellulose aerosol	Nanoclay aerosol	Carbon NanoFibers aerosol
100% polyester (fleece jacket)	Efficient	Not efficient	Efficient	Not efficient	Not efficient	Not efficient
Polyester 65%/ cotton 35%	Efficient	Not efficient	Not efficient	Not efficient	Not efficient	Not efficient
PU coated PA	Efficient	Efficient	Efficient	Efficient	Efficient	Efficient
Rain cloth	Efficient	Efficient	Efficient	Efficient	Efficient	Efficient

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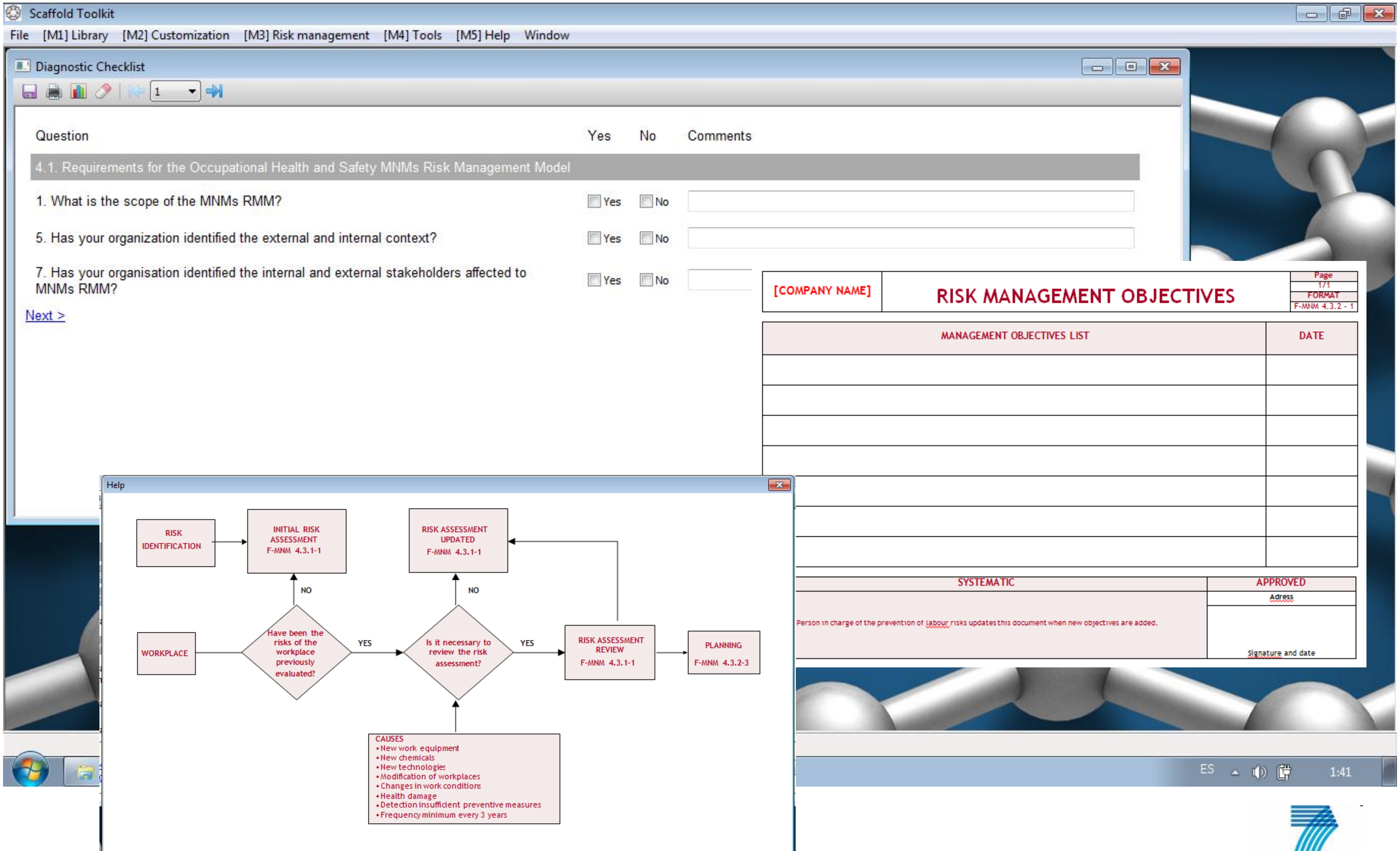

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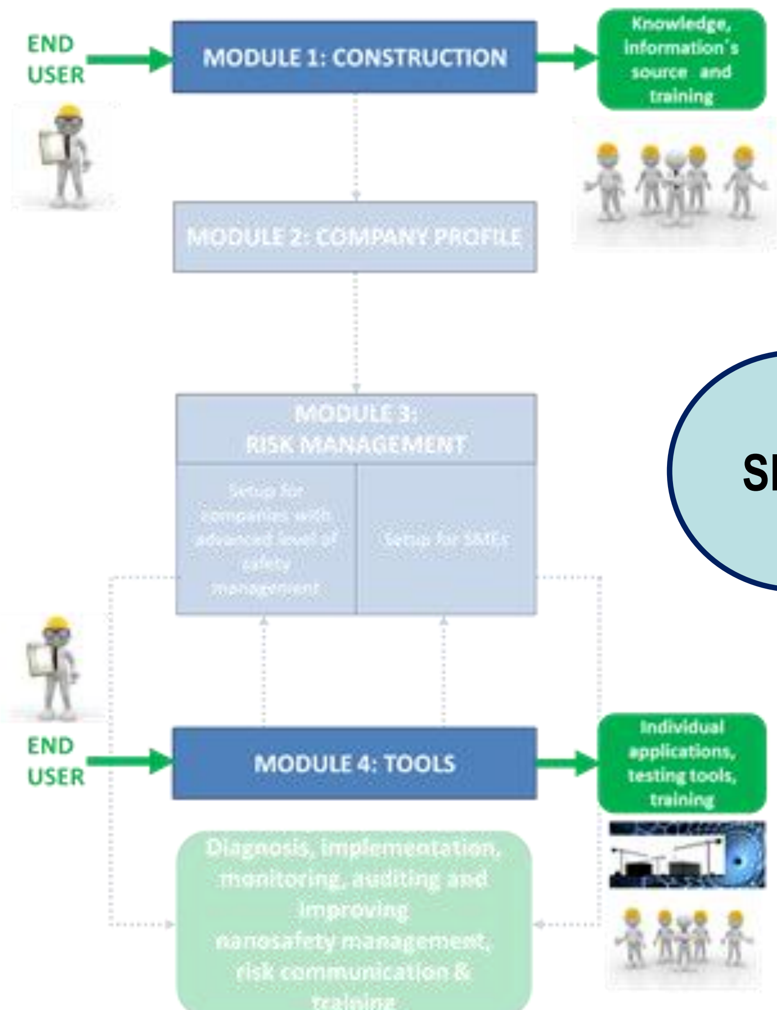
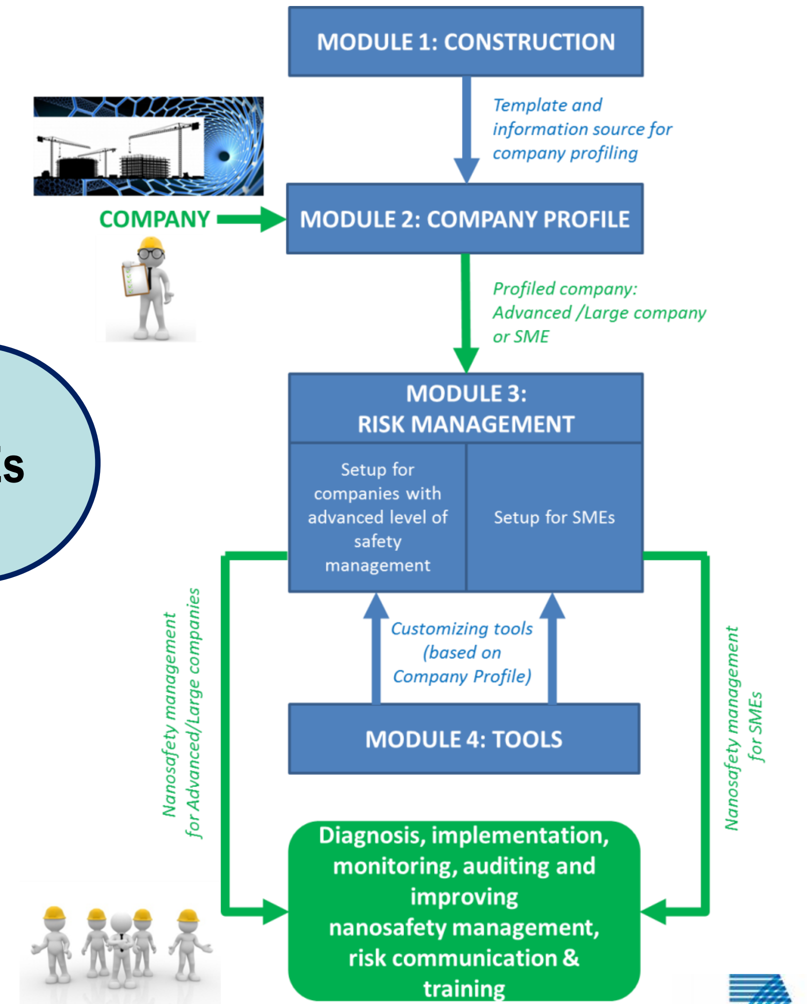
1.- LEARNING / TRAINING MODE (G)



2.- RISK MANAGEMENT MODE (C)

SMEs



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2014-2015

RMM-Toolkit
(DIMA)

SCAFFOLD

Risk Management Model (RMM)

OSHAS 18001

ISO 31000

(RTD)

IMPLEMENTATION AND VALIDATION

IUC 1 TECNAN (Spain)

IUC 2 (T6.2) ICECON (Romania)

IUC 3 MOSTOSTAL (Poland)

IUC 4 ACCIONA (Spain)

IUC 5 ROSSAL (Romania)

Goodbye OHSAS 18001, Hello ISO 45001 ¡

TECNAN ICECON S.A. acciona Mostostal Rossal

DAY	CENTRE	TIME	AUDITOR	PROCESS/ DEPARTMENT/ DOCUMENT/ ACTIVITY	4.1 General requirements	4.2 OHS Policy and management commitment	4.3.1 MNMs hazard identification, risk assessment, and determination of controls	4.3.2 Legal and other requirements	4.3.3 Objectives and programmes	4.4.1 Resources, roles, responsibility and authority	4.4.2 Competence, training and awareness	4.4.3.1 Communication	4.4.3.2 Participation and consultation	4.4.4 y 4.4.5 Documentation and control of documents	4.4.6 MNMs operational control	4.4.7 MNMs emergency preparedness and response	4.4.7 Recuperation from an organization activity interruption	4.5.1 Monitoring and measurements of MNMs risk management activities	4.5.2 Legal compliance evaluation	4.5.3.1 Event and incidents investigation	4.5.3.2 Nonconformity, corrective action and preventive action	4.5.4 Control of records	4.5.5 Internal audit	4.6 Management Review
1	1	9:00-9:30	SCM/LOA	Initial meeting																				
1	2	9:30-10:30	SCM/LOA	General Direction	X																			
1	2	10:30-12:00	SCM	Technological Innovation Direction			X																	
1	2	10:30-12:00	LOA	Prevention Department			X																	
1	2	12:00-14:00	SCM/LOA	Work site				X							X	X			X					
1	2	14:00-15:00	SCM/LOA	Pause																				
1	2	15:00-16:00	SCM/LOA	Technological Innovation Direction								X												
1	1	16:00-17:00	SCM/LOA	Preparation of the audit report by the audit team																				
1	1	17:00-18:00	SCM/LOA	Closing meeting																				

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D6.6 (IUC1, D6.11 (AENOR)

4.- EXTERNAL AUDIT
(16-20 February 2015)
(AENOR - TECNALIA)

VISIT 2

1.- INFORMATION AND FIRST TRAINING (Toolkit β – v0)
(November 2014)
(TECNALIA)

5.- REPORTING
(D6.1, March 2015)
(TECNAN)

VISIT 1

3.- IMPLEMENTATION AND MONITORING AND INTERNAL AUDIT
(November 2014-February 2015)
(TECNAN)

2.- DIAGNOSIS OF THE OHSM (Starting point)
(November 2014)
(AENOR)

- Customized plan IU1
  D5.5 (AENOR) (30-11-2014)
- Training Session (9-12-2014)
- Toolkit β – v1 (9-12-2014)
- Toolkit β – v2 (1-1-2015)
- Technical support

TECNAN
TECNOLOGÍA NAVARRA DE NANOPRODUCTOS, S.L.

IUC1 – TECNAN (SPAIN)

Library of solutions for Risk Management

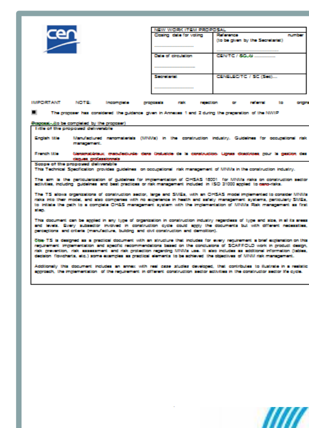
1.- SCAFFOLD TOOLKIT
(TECNALIA)

2.- FOUR QUICK GUIDES:

- Risk Prevention Guide (NETCOMPOSITES)
- Risk Assessment Guide (TECNALIA)
- Risk Protection Guide (CEA)
- Risk Management Guide (AENOR)

4.- STANDARDIZATION
NWI TS/TR (AENOR)

3.- SCAFFOLD HANDBOOK
(AENOR)



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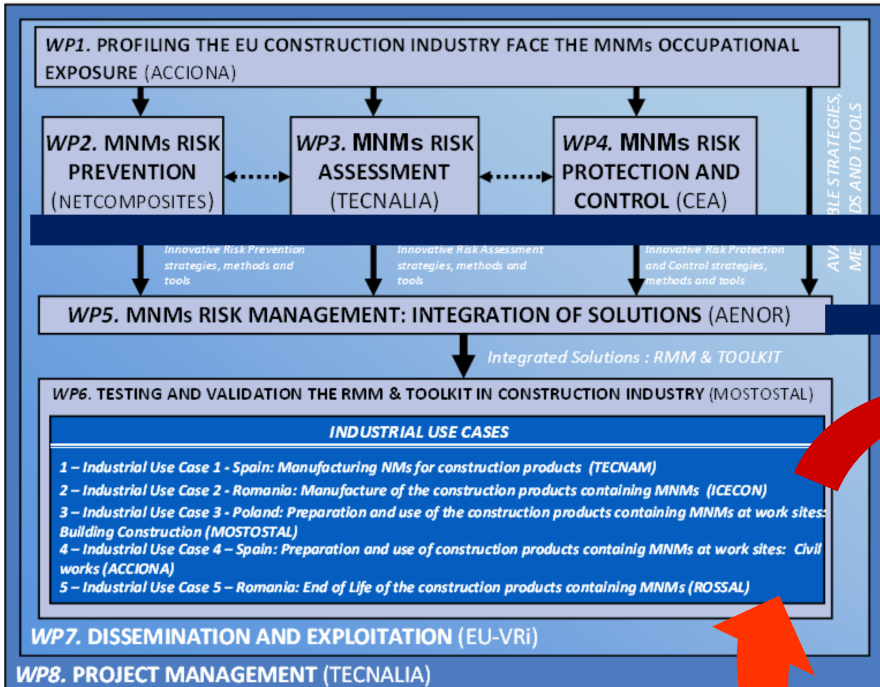

INTEGRATING A COMMON VISION (Delphi workshops)

Best practices guides, Suggested contents:

1.- Mapping the construction sector
2.- Basic knowledge and examples (Windows)
3.- Best practices
Anexes: Definitions, References, Links, Document for workers, etc
(***Same structure for the 4G***)

IMPLEMENTATION

RMM-Toolkit (DIMA)

*"In order to develop a **common vision** and ensure **consensus** partners and stakeholder groups involved in the project, **a one-day Delphi workshop** will be organised to reach these goals".*

Innovative strategies, methods and tools for occupational risks management of manufactured nanomaterials in the construction industry

				KEY EXPLOITABLE RESULTS								EXPECTED IMPACT						
				NEW PRODUCTS				NEW SERVICES										
								ADVANCED SERVICES		CONSULTANCY								
				Dispersions	FRP	Construction products	Device for measuring	Product certification	Exposure measurement	Implementation OHS management	Training	INDUSTRY AND MARKET					OTHER ISSUES	
	PROJECT RESULT	MAIN CONTRIBUTOR	MAIN ASSOCIATED DELIVERABLE	KER1	KER2	KER3	KER4	KER5	KER6	KER7	KER8	Construction industry	Nanotech. sector	Protection and PPE sector	Other industrial sectors	OHS Services	Standard	Regulatory
Products and devices	New dispersions	TECNAN	D2.1, D2.2															CE Mark
	New formulations for FRP	NETCOMPOSITES	D2.3, D2.4															CE Mark
	New formulations for concretes, bituminous pavements, mortars, coatings and insulations	ACCIONA	D2.6															CE Mark
	New device for traping NMs	CEA	D4.7															CE Mark
Strategies and methods	Methods for exposure assessment (measurement & modeling, inhalation & dermal)	TECNALIA, DEMOKRITOS	D3.5, D3.7, D3.9															OHS
	Methods for characterization emissions during a fire	TECNALIA	D2.5, D3.12															CE Mark
	Methods to evaluate efficiency of collective protections and PPEs (respiratory and dermal)	CIOP, CEA	D4.2, D4.4, D4.6															CE Mark
	New procedures ultra sensitive procedures (radioactive NPs)	CEA	D4.8															CE Mark
	Procedure for health monitoring	FIOH	D4.11, D4.12															OHS
	Proposal for OELs	FIOH	D3.11															OHS
	Risk Management Model	AENOR	D5.1, D5.2, D5.3, D5.10															OHS
	Proposal for an European Strategy on occupational exposure to MNMs in constuction	EU-VRi (NERIS)	D7.8															OHS
	New ISO item for PPEs	CEA	D4.8															
	CEN Workshop Agreement	AENOR	D7.6															
Tools	Roadmap for construction	ACCIONA	D1.3															OHS
	Best practice guides: Risk prevention, assessment, protection and management.	NETCOMPOSITES, TECNALIA, CEA, AENOR	D2.7, D3.13, D4.13, D5.12															OHS
	CBA for construction	DEMOKRITOS	D4.9															
	RMM-Toolkit	TECNALIA, AENOR	D5.13															
	Targeted tools for training	ACCIONA	D7.5															
	Technical guide for OHSAS 18001 (MNMs in construction)	AENOR	D7.7															

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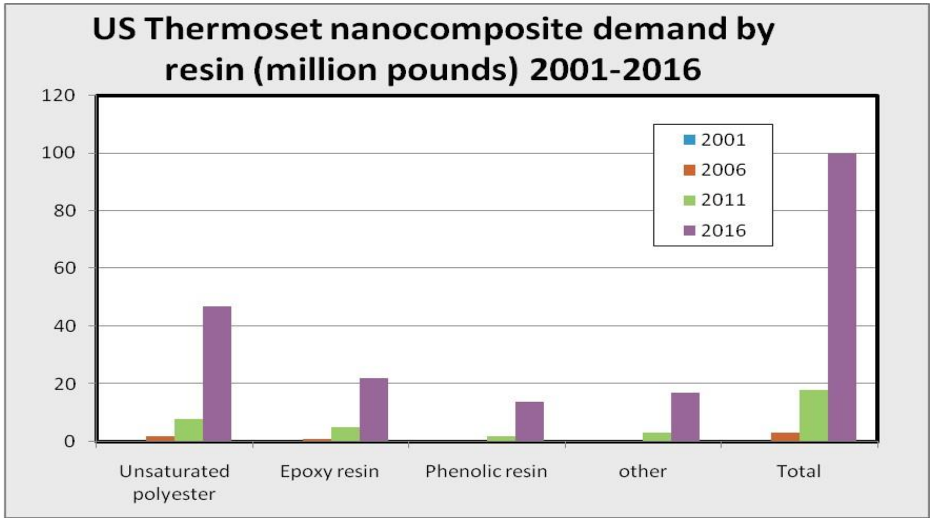
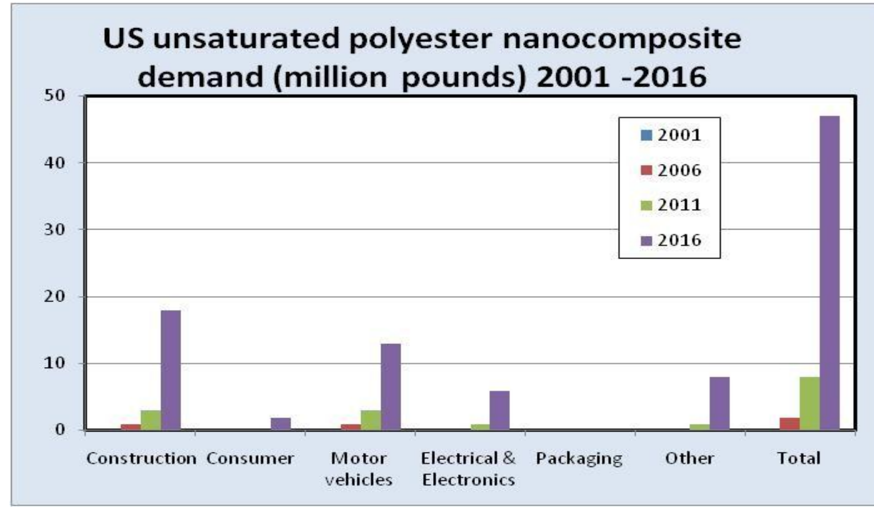
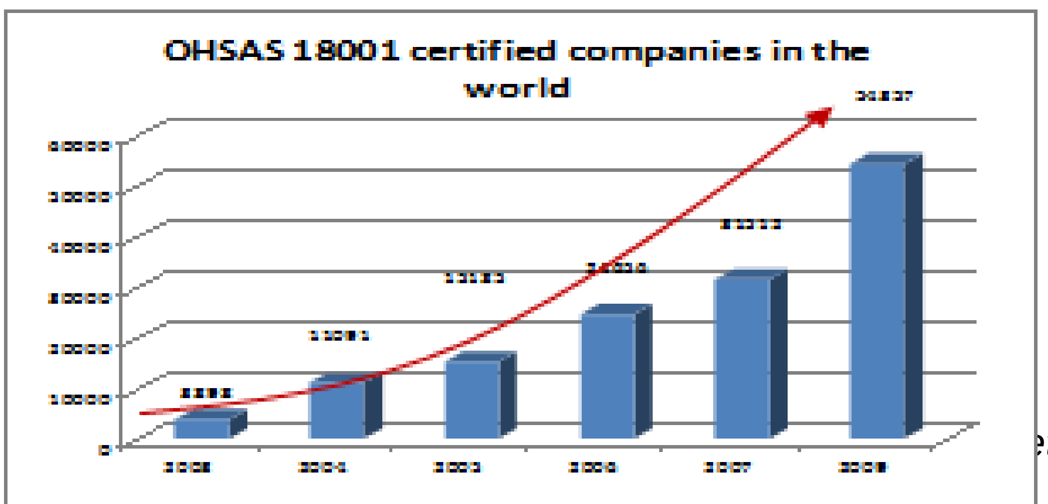


US thermoset composite demand by resin type (showing that unsaturated polyester will have greatest demand).



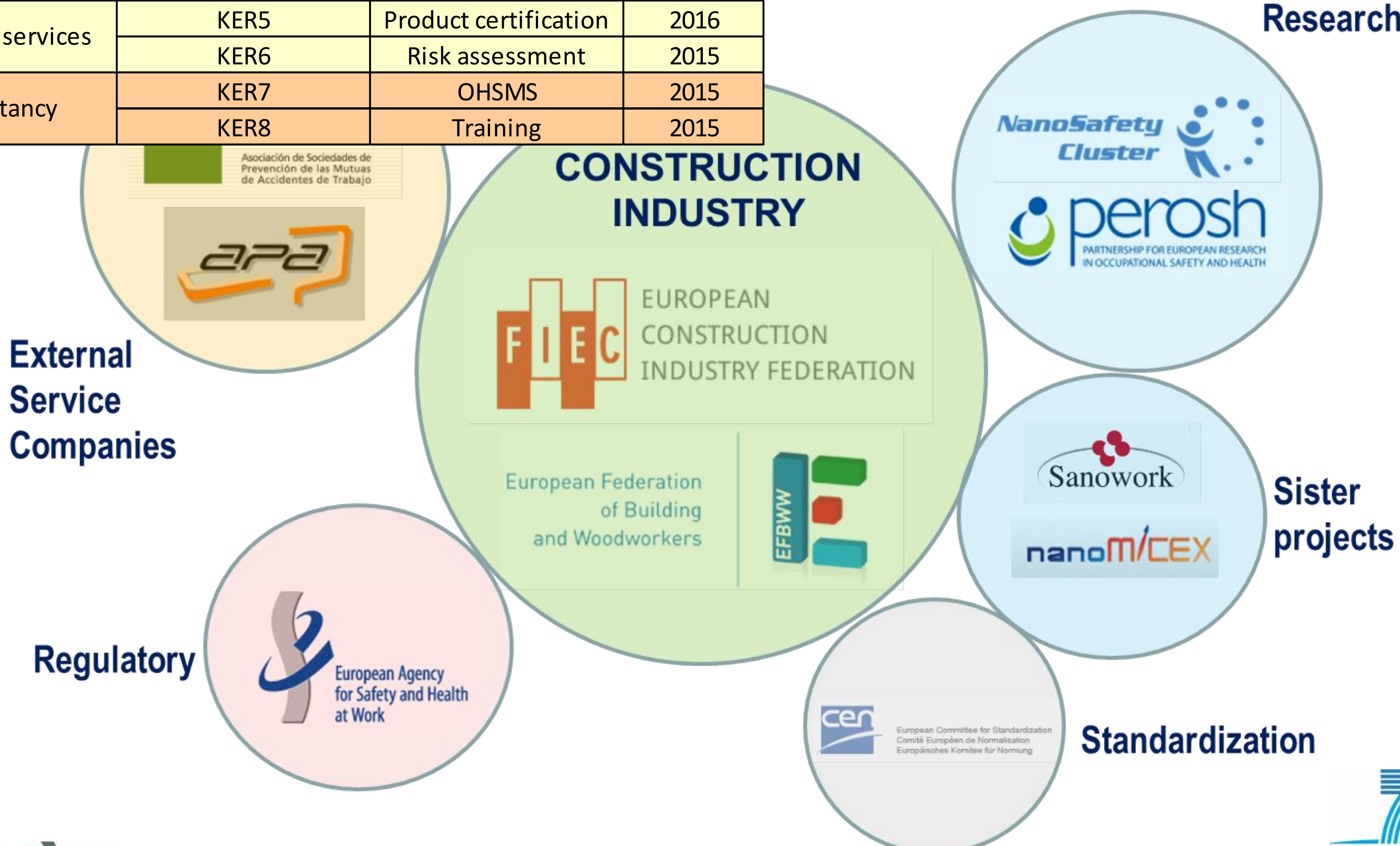
US unsaturated polyester nanocomposites demand by application type (showing that construction will have the greatest demand).



OHSAS 18001 certified companies

Innovative strategies, methods and tools for occupational risks management of manufactured nanomaterials in the construction industry

KER			Market
Safer products	KER1	New dispersions	2015
	KER2	FRP	2017
	KER3	Mortar, concrete, etc	2016
	KER4	New device (trapping)	2016
Advanced services	KER5	Product certification	2016
	KER6	Risk assessment	2015
Consultancy	KER7	OHSMS	2015
	KER8	Training	2015



MARKET	CONSTRUCTION	Safer products, advanced services, consultancy	PUDF
			FIEC & EFBW - IAB: Review and advice
			Websites (link with Library of solutions)
			Specific plan for dissemination (Workshops) (SMEs)
			Larges companies involvement (push forward SMEs) (RM)
			Common vision - Workshops (RM)
	SERVICE COMPANIES (SMEs)	Advanced services , consultancy	PUDF
			Spanish Advisory Group
			Joint workshops with industry (SMEs)
			Project website (link with Library of solutions)
			Common vision - Workshops
OTHER IMPACTS	EU NETWORKING AND COMMUNITY BUILDING		Participation EU-NSC activities: SANOWORK, NONOMICEX, NANOINDEX
			Common vision - Workshops
	EQUIPMENT AND TECHNIQUES		NECID database
			Harmonization workshops
			Strategies, methods and tools (Scaffold)
	INTERNATIONAL COOPERATION		UMN-PTL (Partner)
			NIOSH (MoU): Handbook, Workshop SENN
	SKILLS, TRAINING		Targeted tools for construction (Toolkit)
			Training programmes (Quick guides)
	STANDARDIZATION		Project liaison with CEN TC352
			NWI (Risk Management: OSHAS 18001 vs ISO 45001)
			Common vision - Workshops
	REGULATION		Common vision - Workshops
			Proposal for OHS Strategy
			Wiki OHS
	DISSEMINATION		Conferences
			Scientific publications and handbook
			Workshops
			Websites
			Other

Exporting research into practice

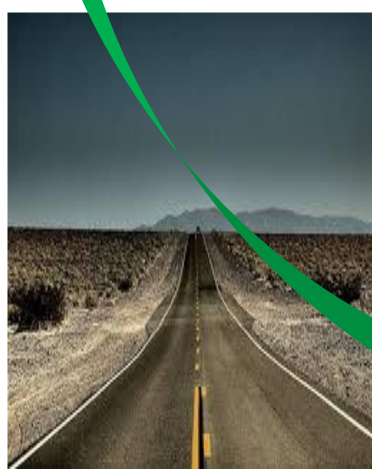
NanoSafety Cluster Roadmap

New projects (TRL 5-7)

RESULTS OF R&D PROJECTS (*)

- Toxicology
- OELs
- Equipment
- Methods
- Management
- Other

"Valley of death"



New Research needs

- Tools
- Guidelines
- Strategies
- Methods
- Best practices
- Other

OHS INDUSTRIAL NEEDS

(*) Nanosafety + other NMBP projects

Thank you very much for your attention

(jesus.lopezdeipina@tecnalia.com)
(http://www.scaffold.eu-vri.eu/)

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